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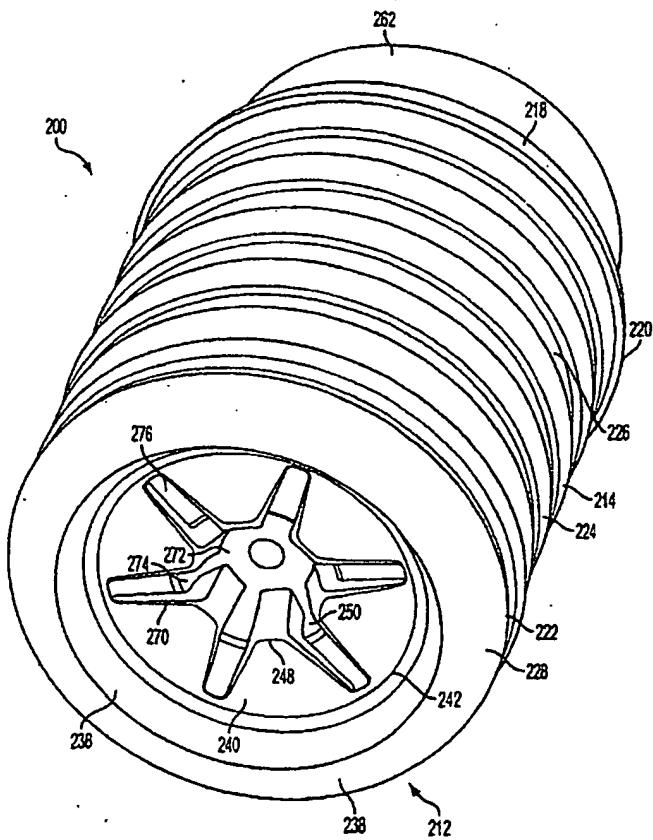
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(54) Title: MULTI-FUNCTIONAL BASE FOR A PLASTIC, WIDE-MOUTH, BLOW-MOLDED CONTAINER



(57) Abstract: A container can have a body with an integrally formed base attached to the body. The base includes a concave annular wall extending from the container sidewall to a standing surface, and an inner wall extending from the standing surface to a substantially flat inner annular wall. The inner annular wall is recessed in the base and is substantially perpendicular to the container sidewall. The inner annular wall includes a centrally located dimple. The dimple includes a plurality of spaced apart and radially extending indented ribs. One or more of the ribs extend radially into a brace that tapers to meet the inner annular wall.



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Multi-Functional Base For A Plastic, Wide-Mouth, Blow-Molded Container

FIELD OF THE INVENTION

The present invention relates to a base for a wide mouth blow-molded plastic container, and more particularly, the present invention relates to a multi-functional base structure which enables use of the container in hot-fill, as well as 5 pasteurization/retort processing.

BACKGROUND OF THE INVENTION

Plastic blow-molded containers, particularly those molded of PET, have been utilized in hot fill applications where the container is filled with a liquid 10 product heated to a temperature in excess of 180° F (82° C), capped immediately after filling, and allowed to cool to ambient temperatures. Plastic blow-molded containers have also been utilized in pasteurization and retort processes, where a filled and sealed container is subjected to thermal processing and is then cooled to ambient temperatures. Pasteurization and retort methods are frequently used for 15 sterilizing solid or semi-solid food products, e.g., pickles and sauerkraut, which may be packed into the container along with a liquid at a temperature less than 82°C (180°F) and then heated, or the product placed in the container that is then filled with liquid, which may have been previously heated, and the entire contents subsequently heated to a higher temperature. Pasteurization and retort differ from 20 hot-fill processing by including heating the contents of a filled container to a specified temperature, typically greater than 93°C (200° F), until the contents reach a specified temperature, for example 80°C (175°F), for a predetermined length of time. Retort processes also involve applying overpressure to the 25 container. In each of these cases, the plastic containers are typically provided with vacuum absorption panels to accommodate volumetric changes in the container as the contents of the sealed container are heated and/or as the contents cool within the sealed container.

U.S. Pat. No. 6,439,413 issued to Prevot et al. and assigned to Graham Packaging Company, L.P. discloses a hot-fillable and retortable plastic wide-mouth blow-molded container having a sidewall with a pair of flex panels. 30

Co-pending U.S. patent application Ser. No. 10/129,885 filed on May 10, 2002 is the U.S. national phase of International Application No.

PCT/US00/31834, is assigned to Graham Packaging Company, L.P., and discloses a pasteurizable wide-mouth container having a novel base.

Other plastic wide-mouth containers having paneled sidewalls are disclosed in U.S. Pat. Nos.: 5,887,739 issued to Prevot et al.; 5,261,544 issued to Weaver, Jr.; and 5,092,474 issued to Leigner. A pasteurizable plastic container having paneled sidewalls and a narrow neck finish is disclosed by U.S. Pat. No. 5,908,128 issued to Krishnakumar et al.

Containers having non-paneled sidewalls and yieldable endwall structures are disclosed in U.S. Pat. Nos. 4,642,968, 4,667,454 and 4,880,129 issued to McHenry et al.; 5,217,737 issued to Gygax et al.; 5,234,126 issued to Jonas et al.; 4,381,061 issued to Cerny et al.; 4,125,632 issued to Vosti et al.; and 3,409,167 issued to Blanchard. The above cited U.S. patents disclose containers having various base structures.

The structure of a so-called footed base is disclosed, in general, in U.S. Pat. Nos. 4,355,728 issued to Yoshino et al., 5,713,480 issued to Petre et al., 3,727,783 issued to Carmichael, 4,318,489 issued to Snyder et al., 5,133,468 issued to Brunson et al., 5,024,340 issued to Alberghini et al., 3,935,955 issued to Das, 4,892,205, 4,867,323 and Re. 35,140 issued to Powers et al., and 5,785,197 issued to Slat.

U.S. Pat. No. 4,321,483 issued to Dechenne et al. discloses a base having slightly angled annular surface and a central conical projection; and U.S. Pat. No. 4,386,701 issued to Galer discloses a blow molded plastic drum having a base which is designed to stack efficiently with the lid of a like drum.

Plastic containers, including those described in the above-mentioned references, have replaced or provided an alternative to glass containers for many applications. However, few food products that must be processed using pasteurization or retort are available in plastic containers. The rigors of such processing present significant challenges for the use of plastic containers, including containers designed for use in hot-fill processing. There remains a need to provide plastic containers that can withstand the rigors of pasteurization and retort processing in order to take advantage of the cost savings that can be realized through manufacture and recycling. The lighter weight of plastic containers as compared to glass can also advantageously reduce shipping costs.

Published International Application No. WO 02/02418 describes a container with a base that can be capable of withstanding the rigors of the pasteurization process. The base includes a large push up section formed with a sharp transition to the container sidewall. The base also must be heat set to a relatively high crystallinity.

While the above referenced containers and base structures may function satisfactorily for their intended purposes, there is a need for a plastic, wide-mouth, blow-molded container which is particularly suited for packaging a variety of viscous and other food products and which has a novel base structure that enables the container to be utilized in hot-fill, pasteurization and retort processes. The base structure should be capable of accommodating increased internal pressure experienced during pasteurization; capable of accommodating vacuum formed in the sealed container during cool down; and capable of resisting unwanted inversion, ovalization or like deformation. A container capable of efficient stacking with like containers is also desirable.

SUMMARY OF THE INVENTION

With the foregoing in mind, an object of the present invention is to provide a commercially satisfactory wide-mouth blow-molded container that can be utilized in hot-fill applications, as well as for pasteurization or retort applications used in for packaging fluent, viscous and solid food products.

Another object of the present invention is to provide a base structure capable of accommodating an increase in internal container pressure when the sealed container is subjected to thermal treatment, and capable of accommodating vacuum during cool down.

Still another object of the present invention is to provide a hot-fillable and pasteurizable container having a base which accommodates changes in internal pressure and volume and which resists unwanted inversion and other deformation.

A further object of the present invention is to provide a structure for a wide-mouth plastic container which can be efficiently stacked, one on top of the other, with like containers and which can be produced by means of high speed manufacturing equipment in an economical manner that ensures consistent quality and performance.

More specifically, the present invention provides a blow molded plastic container having a base with a continuous or discontinuous concave outer annular wall having an outer portion and an inner portion forming a standing ring therebetween. The base also includes an inner annular wall that extends within the outer annular wall and above the standing ring. The inner periphery of the inner annular wall is made of blow molded plastic material that is heat-set and biaxially-oriented and connects to an anti-inverting central dimple. Functionally, the inner annular wall is capable of flexing upwardly and downwardly in response to variations in pressures in a filled and sealed container without undergoing unwanted permanent deformation. In addition, preferably a shoulder extends radially inward on the inner portion of the outer annular wall above a level of the standing ring to facilitate vertical stacking of containers having like bases.

In a particular embodiment, the container includes a body having an integrally formed base that includes a concave annular wall extending from a sidewall of the container to a standing surface, an inner wall that is substantially perpendicular to the sidewall and extends from the standing surface to a substantially flat inner annular wall. The concave annular wall can be continuous. A dimple is centrally located within the inner annular wall and includes a plurality of spaced apart radially extending indented ribs. Each rib has a brace that extends radially from the dimple and tapers to meet the inner annular wall. The ribs can also include a rib wall; and a brace ledge tapering from the rib wall to the inner annular wall. a rib wall; and a brace ledge tapering from said rib wall to the inner annular wall. A brace sidewall extending from said brace ledge to said inner annular wall.

The container can be made of a blow molded plastic material, and the degree of crystallinity of the plastic material in the base is greater than the degree of crystallinity of the plastic material in the sidewall. The degree crystallinity in the base can be greater than 20% and can be less than 30%. The sidewall diameter can be no more than 50% greater than the inner diameter of the standing surface.

The inner annular wall of the base is adapted to flex upwardly and downwardly in response to variations in pressures within the container, when capped and filled, without undergoing unwanted permanent deformation.

The invention is also a method of improving resistance to base deformation in a blow molded plastic container comprising forming a concave annular wall extending from an extremity of the base to a standing surface, forming an inner wall extending from the standing surface to a substantially flat inner annular wall that is substantially perpendicular to the sidewall; and forming a centrally located dimple within the inner annular wall and a plurality of spaced apart radially extending indented ribs, each of the ribs comprising a brace extending radially from the dimple and tapering to meet the inner annular wall.

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BRIEF DESCRIPTION OF THE DRAWINGS

The foregoing and other objects, features and advantages of the present invention should become apparent from the following description when taken in conjunction with the accompanying drawings, in which:

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FIG. 1 is a perspective view of a container having a base according to an embodiment of the present invention;

FIG. 2 is an elevational view of the container illustrated in FIG. 1;

FIG. 3 is bottom plan view of the base illustrated in FIG. 1;

FIG. 4 is a cross-sectional view of the base taken along line IV--IV of FIG. 3;

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FIG. 5 is a cross-sectional view of the base taken along line V-- V of FIG. 2 and illustrates a pair of containers in a stacked arrangement;

FIG. 6 is a perspective view of a container having a base according to another embodiment of the invention;

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FIG. 7 is a bottom view of the base according to the embodiment illustrated in FIG. 6;

FIG. 8 is a cross-section of the base of FIG. 6 taken along the VIII -- VIII line of FIG. 7; and

FIG. 9 is a cross-section of the base of FIG. 6 taken along the line IX -- IX of FIG. 7.

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DETAILED DESCRIPTION OF THE INVENTION

An embodiment of the present invention is illustrated in FIGS. 1-5 as container 100. Container 100 has a base 112, a tubular sidewall 114, and a wide-mouth threaded finish 116 which projects from the upper end of the sidewall 114

via a shoulder 118. In the illustrated embodiment, upper and lower label bumpers, 120 and 122, are located adjacent the shoulder 118 and base 112, respectfully, and outline a substantially cylindrical label area 124 on the sidewall 114. Containers according to the invention can have cross-sectional shapes other than circular. In addition, the sidewall 114 can have a series of circumferential grooves 126 which reinforce the sidewall 114 and resist paneling, dents and other unwanted deformation of the sidewall 114.

The container 100 is multi-functional since it can be utilized in hot-fill as well as pasteurization and retort processing. To accomplish this objective, the base 112 has a structure which is capable of accommodating elevated internal container pressure experienced during pasteurization or retort processing, and which is capable of accommodating reduced container volume and pressure experienced upon cool down of a filled and sealed container after hot-fill, pasteurization or retort processing. To this end, the base 112 can flex downwardly in a controlled manner and to a desired extent when pressure within the filled and sealed container is elevated, and the base 112 can flex upwardly in a controlled manner and to a desired extent when a vacuum develops within the filled and sealed container.

Structurally, the base 112 includes a concave outer annular wall 128 that is either continuous or discontinuous. FIGS. 1-5 illustrate an embodiment of the base 112 having a discontinuous concave outer annular wall 128 that provides a plurality of spaced-apart, arcuate supports 130 adjacent the outer periphery 132 of the base 112. Each support 130 has an outer wall portion 134 that extends upwardly toward the lower label bumper 122 and an inner wall portion 136 that extends upwardly and inwardly into the remaining base structure as will be discussed. A standing surface 138 is formed at the juncture of each outer and inner wall portions, 134 and 136, thereby forming a discontinuous support ring of the container 100. FIGS 6-9 illustrate an embodiment of a base 212 having a continuous concave outer annular wall 228 that forms a continuous standing surface 238, as described more fully below.

An inner annular wall 140 of base 112 extends within the concave outer annular wall 128. The inner annular wall 140 has an outer periphery 142 and an inner periphery 144. The outer periphery 142 of the inner annular wall 140

merges with the inner wall portion 136 of each of the supports 130 and, in the illustrated embodiment, with a plurality of spaced-apart, horizontally-disposed, radial webs 146 located adjacent the outer periphery 132 of the base 112. Each of the webs 146 extends between the supports 130 and connects to the container 5 sidewall 114 at an elevation above the horizontal plane "P" extending through the standing surface 138. In an embodiment of the present invention in which the concave outer annular wall 128 is continuous, webs 146 are not provided. The inner periphery 144 of the inner annular wall 140 merges into an anti-inverting central dimple 148.

10 The inner annular wall 140 functions as a flex panel. To this end, when the internal pressure increases within a filled and sealed container, the inner annular wall 140 flexes downwardly to accommodate the increased pressure and to prevent the sidewall 114 of the container 100 from undergoing unwanted permanent distortion. In addition, the inner annular wall 140 flexes upwardly to 15 relieve vacuum when the contents of a hot filled and capped container, or a filled, capped and subsequently pasteurized container, cool to ambient. Thus, when the sealed container and contents cool to ambient temperative, the sidewall 114 is substantially unchanged from its as-formed shape and is capable of neatly supporting a wrap-around label without unwanted voids or the like beneath the 20 label. In addition, the sidewall 114 resists ovalization and the base 112 provides a level seating surface which is not subject to rocking or the like.

25 The base 112 of container 100 is specifically designed to provide flexural movement. Increasing flexure of the base 112 is accomplished by providing a larger circular flat between the dimple 148 and the arcuate supports 130. Thus, the inner annular wall 140 of container 100 is relatively large compared to other containers of a similar size. To this end, the diameter, size, or extent of the central dimple 148 is reduced and the inner diameter of the arcuate supports 130 is increased relative to prior art container.

30 The relatively large flat surface provided by inner annular wall 140 provides greater flexure; however, it can also be more prone to "roll out", i.e. becoming permanently deformed in an outwardly projecting position when its contents are hot-filled or heated at relatively high temperatures, such as those encountered during pasteurization or retort processing. This is because an

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amorphous ring of material is created at the interconnection of the inner periphery 144 of the inner annular wall 140 and the dimple 148 due to the reduced size of the dimple 148. This ring of unoriented, non heat-set material provides a weakened area that permits the base to "roll out" when filled and sealed with contents at high temperatures.

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The base 112 of the present invention overcomes the "roll out" problem by providing a series of spaced-apart, radially-extending, hollow, indented ribs 150 in the dimple 148 where the inner periphery 144 of the inner annular wall 140 interconnects to the central dimple 148. The structure provided by the ribs 150 causes the material in this region to be stretched during blow molding of the container 100 so that the ring of material adjacent the interconnection of the dimple 148 and inner annular wall 140 is both heat-set and the extent of biaxial orientation increased to structurally reinforce the base and prevent "roll out" of the base 112. If desired, the dimple 148 can be indented to a given extent into the container 100 to provide additional stretching, and the total number of ribs 150 can be three or more, such as six as illustrated in FIG. 1. In addition, the shape and size of the ribs can vary as long as the blow molded plastic material forming the base at the interconnection of the dimple 148 and inner annular wall 140 has sufficiently increased biaxial orientation and is heat-set by heated surfaces of a blow mold.

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Thus, the inner annular wall 140 flexes downwardly when the container is filled, capped and subjected to an increase in pressure within the container. However, complete inversion and failure is prevented by the reinforcement ribs 150 formed in the dimple 148, which travel with the inner annular wall 140. The ribs 150 and dimple 148 maintain a substantially constant shape regardless of the internal pressure experienced within the container, due to the increase in density and stiffness resulting from the increased orientation.

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Another feature of the base 112 of the present invention is that each inner wall portion 136 of the arcuate supports 130 can have an arcuate shoulder, or support ridge, 156 formed therein and spaced in elevation from both the support surfaces 138 and the inner annular wall 140 to facilitate vertical stacking of like containers 100. For example, as illustrated FIG. 5, an upper container 100a can be stacked on a lower container 100b. The support ridge 156 in the base 112a of the

upper container 100a seats on the outer edge 158 of the upper surface 160 of the lid 162 of the lower container 100b such that the horizontal plane "P_a" extending through the standing surfaces 138a of the upper container 100a extends a spaced distance beneath the top surface 160 of the lid 162 of the lower container 100b.

5 By way of example, and not by way of limitation, the container 100 according to the present invention preferably has a height "H" of about 5.8 inches, a container outermost diameter "D" of about 4.2 inches, and can contain a capacity of about 32 fluid ounces. The discontinuous standing ring formed by the standing surfaces 38 has a diameter of about 3.7 inches, and the inner annular wall 140 of the base 112 has an inner periphery 144 with a diameter of less than about 1.25 inches and an outer periphery 142 with a diameter of at least about 2.5 inches. 10 The radial webs 146 are uniformly spaced apart and separate each support 130 such that each support 130 is at least about 0.8 radians. In addition, each support 130 has a larger arcuate extent than that of each radial web 146.

15 FIGS. 6-9 illustrate a second embodiment of a base 212 that may be used on a container 200 according to the present invention. Other than the base 212, the container 200 can be the same as or different from container 100. Accordingly, the last two digits in reference numerals used to designate features of the container 200 are the same as the reference numerals that are used to 20 designate the related features in container 100. For example, the container 200 can include a threaded finish 216 that can be the same as the threaded finish 116 of the first embodiment, and can accommodate a closure 262 having complementary threads. Similarly, the shoulder 218, upper bumper 220, circumferential grooves 226, label area 224, and sidewall 214 can be structurally 25 similar to the corresponding features of the first embodiment.

The second embodiment of the base 212 includes a continuous concave outer annular sidewall 228. The outer portion 228 of the annular sidewall curves from the sidewall 214 toward the center of the container 200 to form a continuous standing surface 238. The standing surface 238 is formed as a continuous, 30 circular surface. Further, the transition from the outer annular sidewall 228 to the standing surface 238 is gradual and continuous. An inner portion 236 of the outer annular sidewall extends from the standing surface 238 to a substantially flat inner

annular wall 240. The outer periphery 242 of the inner annular wall 240 forms a continuous ring around the inner annular wall 240.

Approximately centrally located on the inner annular wall 240 is a dimple 248. Extending outwardly from the dimple 248 are a series of ribs 250. The dimple 248 of this embodiment can be substantially the same size as the dimple 148 in the first embodiment 100, or can be slightly larger. The ribs 250 of the second embodiment extend outwardly to form a series of radially placed braces 270, which taper to an elevation that meets the flat inner annular wall 240 before, near, or the outer periphery 242 of the inner annular wall. In the illustrated embodiment, the ribs 250 first extend outward from the dimple at a similar depth to the inner portion 272 of the dimple to a rib wall 274, where there is a relatively abrupt change in depth toward the inner annular wall 240. The rib wall 274 extends up to a brace ledge 276 which slopes towards the surface of the inner annular wall 240. The brace ledge 276 can meet the surface of the inner annular wall 240 at or before the outer periphery 242. The sidewall of the brace 278 extends upward from the brace ledge 276 to the surface of the inner annular wall 240. The brace sidewall 278 meets the inner annular wall 240 at a periphery of the brace 270. The sidewall of the brace 278 can be substantially perpendicular to the inner annular wall 240 and the brace ledge 276.

20 The inner annular wall 240 in base 212 flexes in a manner analogous to the
inner annular wall 140 of base 112. The radially spaced braces 270 further control
flexure of the annular wall 240 in response to the reduced pressures that occur
when the container cools down during hot-fill processing, and the reduced and
increased pressures that occur during pasteurization and retort processing. The
presence of the braces 270 allows greater flexure of the inner annular wall 240
25 within the concave outer annular wall 228 without allowing permanent
deformation of the base. In addition, the presence of a continuous outer annular
wall 228 is useful during rigorous pasteurization or retort conditions. Under such
conditions, a discontinuous outer sidewall that has feet can have a tendency for the
feet to pull in, causing the lower bumper to move into a square shape. By having
30 a continuous standing surface 238 and a continuous outer annular sidewall 228,
this tendency is reduced. Further, the presence of a continuous standing surface
238 alleviates any tendency for excessive base rollout.

The base structure described herein is illustrated without a support ridge 156 (see FIGS 1-5) for stacking of containers. Such a ridge or shoulder can, however, be readily incorporated into a base 242 according to this second embodiment of the invention.

5 The base 212 according to the present invention is preferably crystallized to some extent as previously described in the first embodiment. Some degree of crystallinity and biaxial orientation is achieved normally during the blow molding process. Crystallization can also be promoted through heat setting of the container. For example, the walls and base of the mold can be held at an elevated
10 temperature to promote crystallization. When the container is heat set at a temperature of about 180°F, the container sidewalls, base, dome, and threads can be typically crystallized to about 20%. This degree of crystallinity is typical for a blow molding process and does not represent a significant amount of heat setting or increased crystallinity or orientation, as compared with a typically prepared
15 container. However, the properties of the base of the present invention can be advantageously enhanced by heat setting the container, and particularly the base, at ever higher temperatures. Such temperatures can be, for example, greater than 250°F and can be 325°F or even higher. When these elevated heat set temperatures are utilized, crystallinity can be increased to greater than 20% or
20 25% or more. One drawback of increasing crystallinity and biaxial orientation in a plastic container is that this process introduces opacity into the normally clear material. However, unlike bases in prior art containers designed for use in pasteurization and retort processes, which can require a crystallinity of 30% or more, utilizing crystallinities of as low as 22 – 25% with a base structure
25 according to the present invention can achieve significant structural integrity, while maintaining the substantial clarity of a base that is preferred by manufacturers, packagers and consumers of such pasteurized commodities. Crystallinities of 30% or greater that are frequently utilized in prior container to achieve significant structural integrity can cause undesirable opacity in the base region.
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Bases formed with configurations according to the present invention provide a more appealing structure to consumers, packagers and manufacturers for other reasons, as well. For example, when switching from the use of glass to

plastic in packaging such pasteurizable commodities, design changes cause undesirable changes in the internal container configuration. Typically, in order to withstand the rigors of pasteurization or retort processing, prior containers have included a base formed with a large central push-up, as is used in typical plastic containers used in hot-fill processes. This push-up limits the volume of material that can be placed in the container in the internal region between the push-up and the sidewalls. This can be particularly problematic when solid products, for example, pickles, are packaged. The presence of narrow channels which are formed between the sidewall and large base push-up in the internal space of a typical blow molded container, can limit the volume into which solid materials can be placed. That is, such designs create dead space within the container that can be filled by liquid, but not by the solid product. In traditional glass containers, a relatively flat bottom can be formed which allows solids to be packed throughout the vertical and radial extent of the container. Prior art plastic containers that have been utilized to withstand the pasteurization and retort conditions have used similar internal geometry, which creates dead space.

According to the present invention, and particularly according to the second embodiment described herein, the configuration of the base can reduce the amount of dead space and be much more similar to traditionally used glass containers. For example, the substantially flat inner annular wall 240 can extend to a substantial outward extent toward the edge of the container. By using a base configuration according to the present invention, the inner diameter of the standing surface, i.e. the pushed-up region of the base D_1 , as shown in FIG. 9, can be a relatively large portion of the container diameter D_2 . According to the present invention, the ratio of the container diameter D_2 to the pushed-up diameter D_1 can be less than 1.5:1.0 and even 1.3:1.0 or lower. Stated differently, the diameter of the container D_2 can be less than 50% larger than, or as little as about 30% larger than, the diameter of D_1 of the pushed-up region. In cases where the container is not round, this corresponds to a projected volume of the sidewall region less than 70% greater than the projected area of the push-up region.

By way of example, and not by way of limitation, the container 200 according to the present invention can have dimensions similar to those of the container 100. For example, the container can have a height of about 5.8 inches,

an outermost diameter D_2 of about 3.8 inches, and can contain a capacity of about 32 fluid ounces. The pushed-up region of the base can have a diameter D_1 of about 3.1 inches. The brace 270 can have a brace ledge 276 that extends out about 0.6 inches from the dimple 248. The distance between opposite rib walls 274 can be about 1.2 inches, while the distance across the dimple 248 in the region between ribs can be about 0.9 inches.

The containers 100 and 200 can be blow molded from an injection molded preform made from, for example, PET, PEN or blends thereof, or can be extrusion blow molded plastic, for example, polypropylene (PP). In addition, the containers 100 and 200 can be multilayered, including a layer of gas barrier material or a layer of scrap material. Resins also include polyester resins modified to improve UV resistance, for example HeatwaveTM CF246, available from Vordian (Kingsport, Tennessee, U.S.A.). The finishes of the containers can be injection molded, i.e. the threaded portion can be formed as part of the preform, or can be blow molded and severed from an accommodation feature formed thereabove, as is known in the art.

The above described containers 100 and 200 are capable of use, for instance, in hot-fill operations having fill temperatures up to about 205° F. As explained above, containers 100 and 200 having base 112 and 212 can be utilized when processing temperatures approach or exceed 205° F. The containers can also be utilized in typical pasteurization processes used in the packaging art. In an exemplary process, a cold solid product, such as pickles, is combined with mildly heated brine at 120 to 140° F within the container. After the container is capped, the filled container can be processed through a pasteurization tank, where temperatures approach about 212° F, so that the solid products in the sealed container are heated to approximately 175° F for 15 minutes before the filled and sealed container is cooled to ambient temperature.

While preferred containers and base structures have been described in detail, various modifications, alterations and changes may be made without departing from the spirit and scope of the present invention as defined in the appended claims.

WE CLAIM:

1. A container comprising

a blow molded plastic body having an integrally formed base, said base comprising:

a concave outer annular wall having an inner portion extending from a sidewall of the container to a standing surface and an outer portion extending from the standing surface to a substantially flat inner annular wall that is substantially perpendicular to the sidewall; and

said inner annular wall having an inner periphery connecting to an anti-inverting central dimple that projects from said inner periphery of said inner annular wall;

said inner annular wall of said base flexing upwardly and downwardly in response to variations in pressures within the container, when capped and filled, without undergoing unwanted permanent deformation.

2. The container according to claim 1, wherein said inner periphery is made of blow molded plastic material that is at least partially heat-set and biaxially-oriented.

3. A container according to claim 2, wherein said concave outer annular wall is continuous.

4. A container according to claim 2, wherein said concave outer annular wall is discontinuous.

5. The container according to claim 4, said inner annular wall connecting to said inner portion of said concave annular wall at an outer periphery, said outer periphery having a plurality of radial webs extending outwardly at an elevation above said standing ring.

6. A container according to claim 2, wherein said central dimple includes an indented, substantially-circular surface having indented hollow ribs formed therein.

7. A container according to claim 2, further comprising a plurality of spaced-apart, radially-extending, indented ribs on said base where said inner periphery of said central annular wall interconnects to said central dimple.

8. The container according to claim 1, said dimple comprising a plurality of spaced apart radially extending indented ribs, each of said ribs comprising a brace extending radially from said dimple and tapering toward said inner annular wall.
9. The container according to claim 8, wherein said concave annular wall is continuous.
10. The container according to claim 8, said ribs further comprising a rib wall; and a brace ledge tapering from said rib wall toward inner annular wall.
11. The container according to claim 10, further comprising a brace sidewall extending from said brace ledge to said inner annular wall.
12. The container according to claim 8, wherein the container comprises a blow molded plastic material and wherein a degree of crystallinity of the plastic material in the base is greater than a degree of crystallinity of the plastic material in the sidewall.
13. The container according to claim 12, wherein the degree crystallinity in the base is greater than 20%.
14. The container according to claim 12, wherein the degree crystallinity in the base is less than 30%.
15. The container according to claim 8, wherein the sidewall diameter is no more than 50% greater than the inner diameter of the standing surface.
16. The container according to claim 8, wherein said container and base is made of PET, wherein the sidewall has a diameter of about 3.8 inches, and the diameter of the standing surface is about 3.1 inches.
17. The container according to claim 8, wherein said brace tapers to meet said inner annular wall.
18. A container according to claim 1, wherein said inner portion of said outer annular wall has a support ridge formed therein above a level of said container standing surface to facilitate vertical stacking of containers having like bases.
19. A container according to claim 1, wherein said standing ring has a diameter of at least about 3.7 inches, and said inner periphery of said central annular wall is less than about 1.25 inches.
20. A container according to claim 1, further comprising a thin-walled body extending upwardly from said outer annular wall and having a blown wide-mouth

threaded finish at an upper end of said body.

21. The container according to claim 1, wherein said base is substantially circular and said sidewall is substantially circular.

22. A container according to claim 1, said sidewall comprising a substantially cylindrical label panel having a plurality of longitudinally spaced circumferential reinforcement grooves and outlined by an upper and lower label bumper.

23. A method of improving resistance to base deformation in a blow molded plastic container comprising

forming a concave annular wall extending from an extremity of the base to a standing surface;

forming an inner wall extending from the standing surface to a substantially flat inner annular wall that is substantially perpendicular to the sidewall; and

forming a centrally located dimple within said inner annular wall and a plurality of spaced apart radially extending indented ribs, each of said ribs comprising a brace extending radially from said dimple and tapering toward said inner annular wall.

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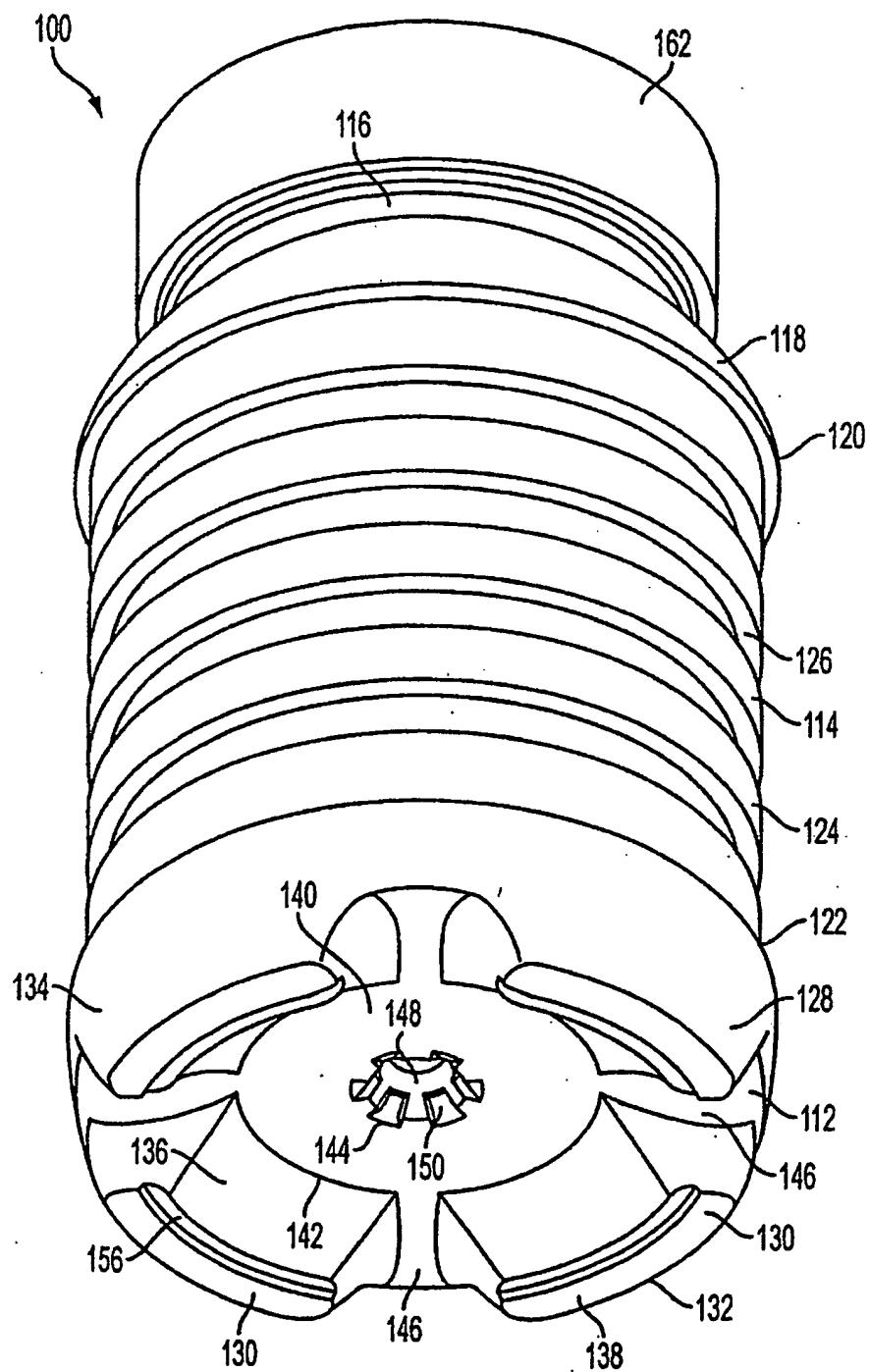


FIG. 1

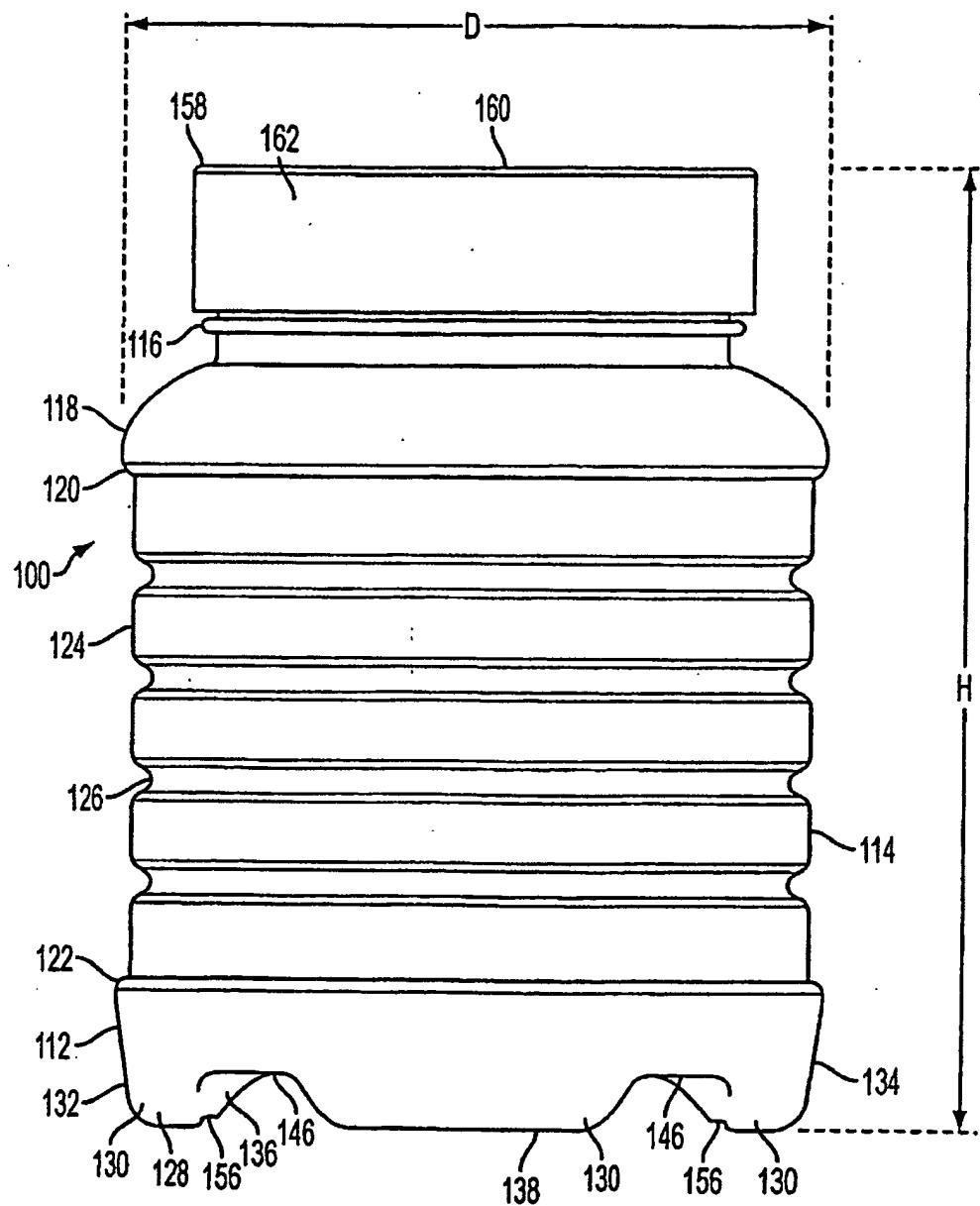


FIG. 2

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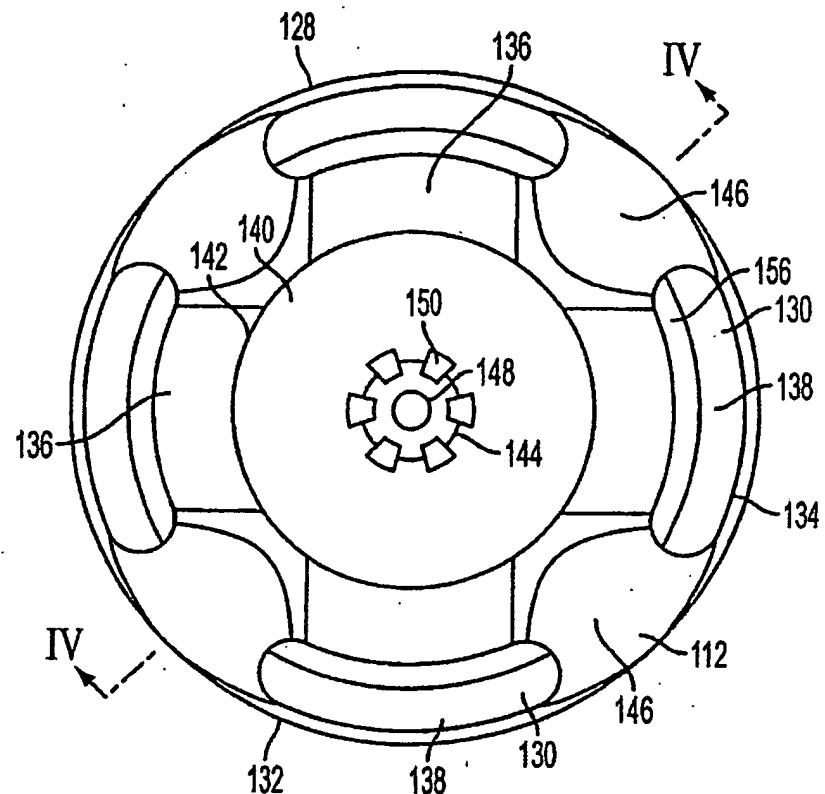


FIG. 3

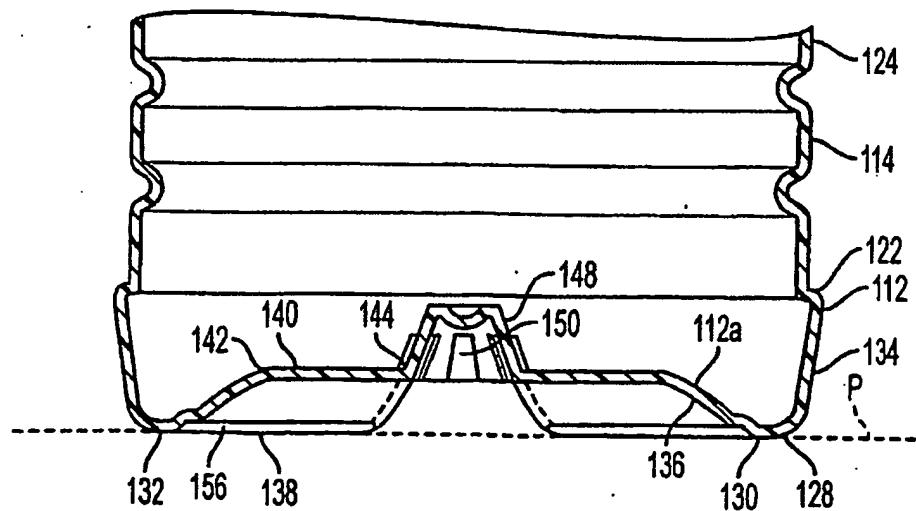


FIG. 4

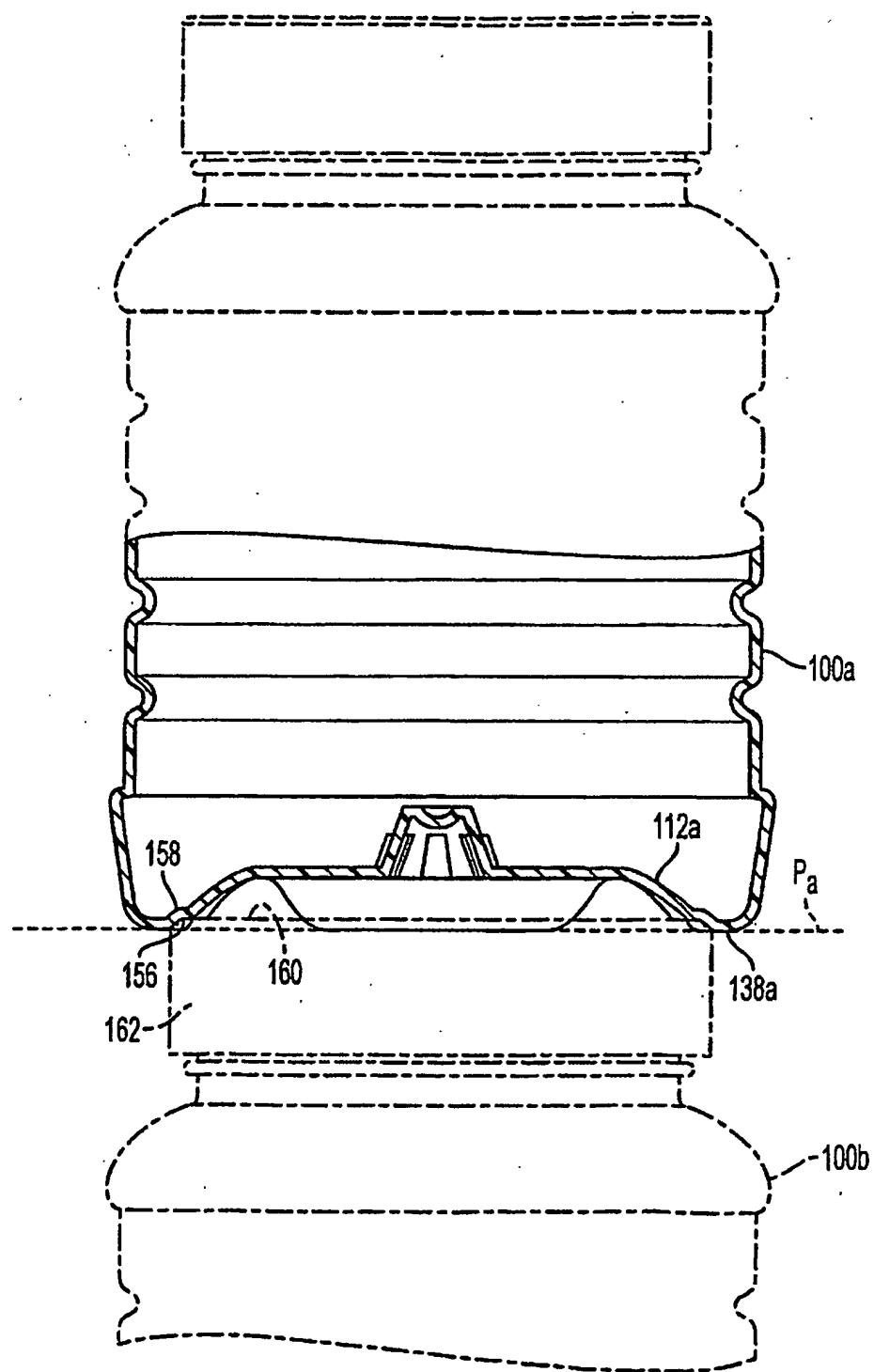


FIG. 5

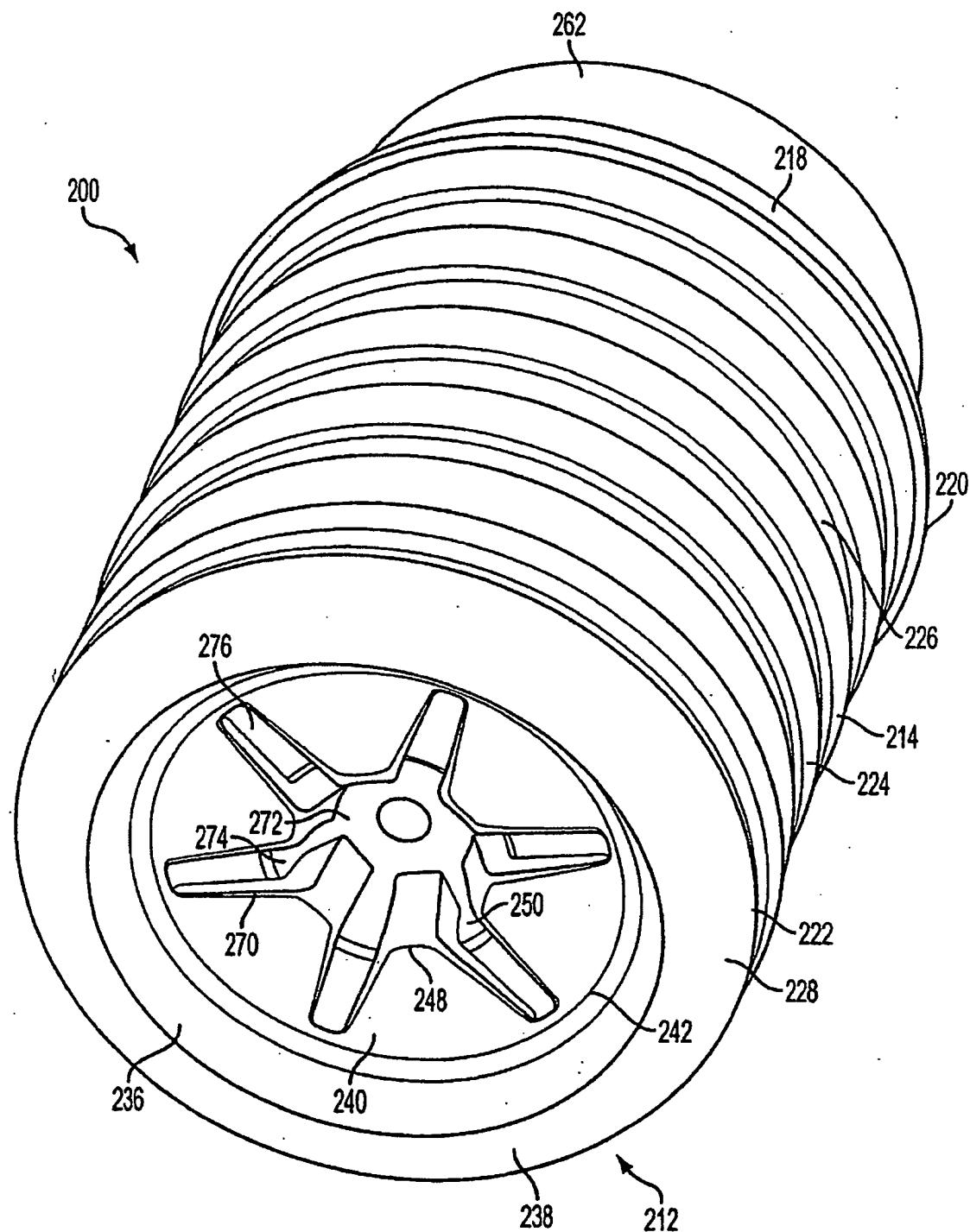


FIG. 6

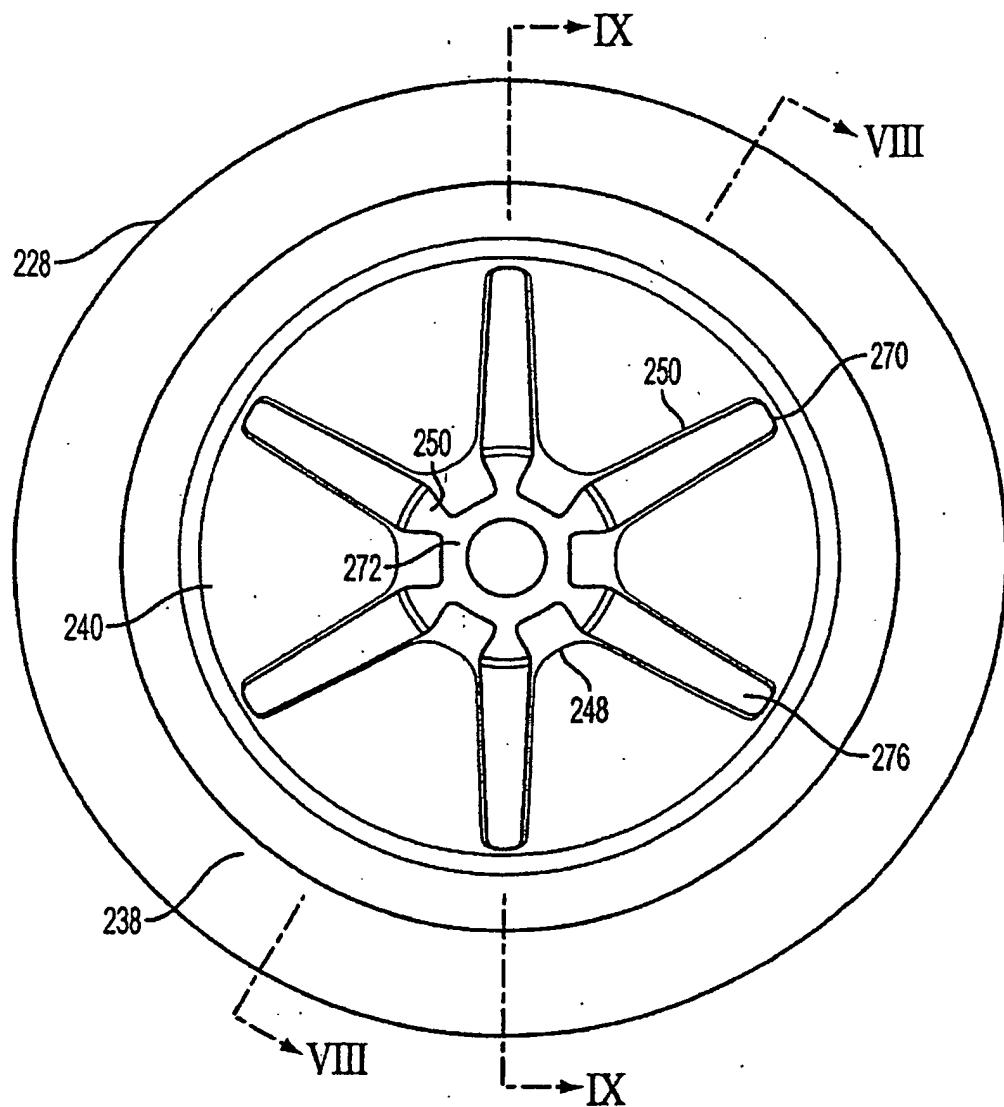


FIG. 7

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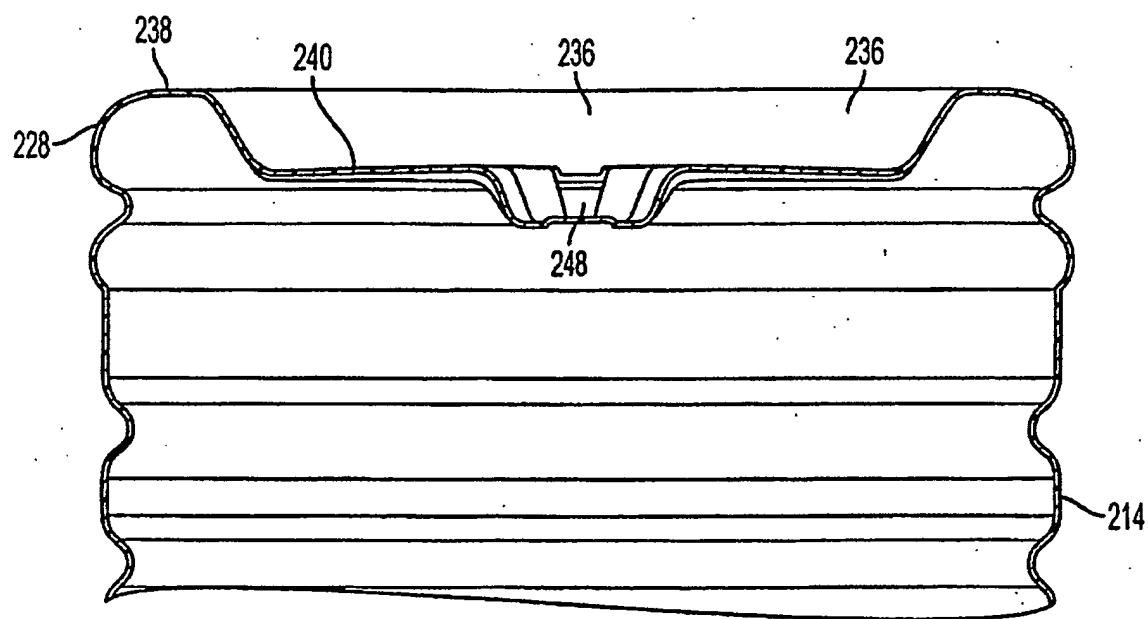


FIG. 8

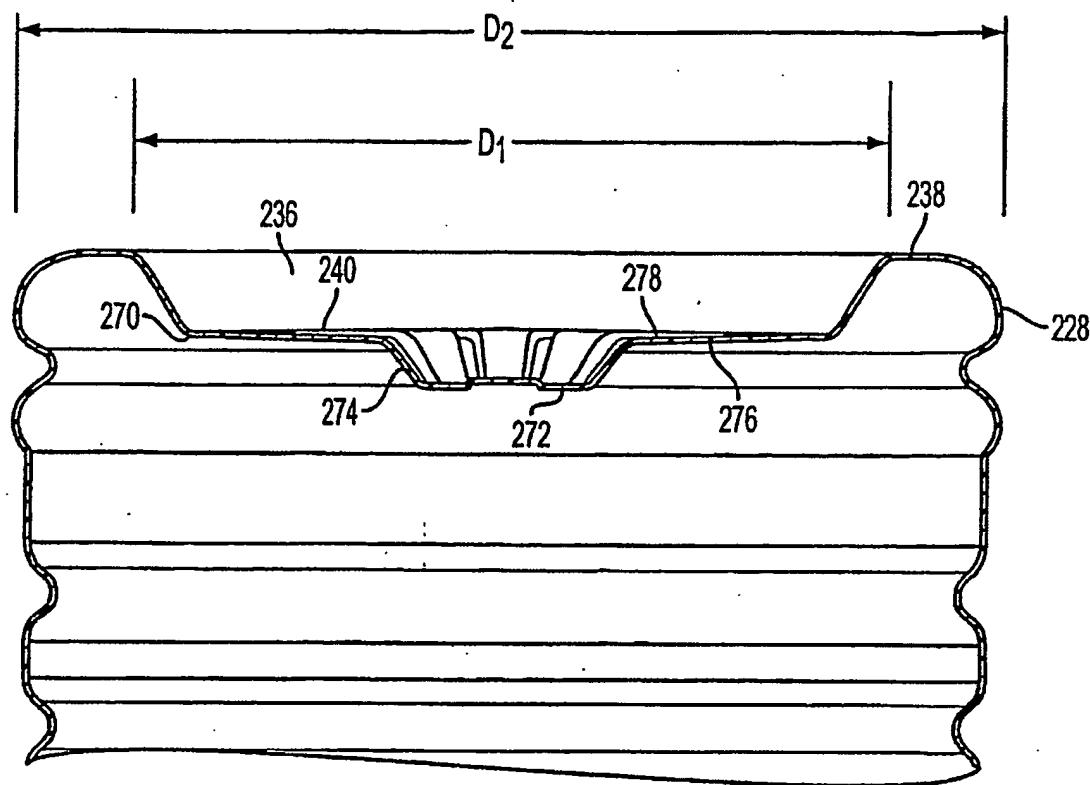


FIG. 9